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CORRECTIVE ACTION PLAN FOR SITE 25 BUILDING 1346 ZONE F SITE IDENTIFICATION NUMBER 14067 WITH TRANSMITTAL CNC CHARLESTON SC
5/1/2001
J A JONES ENVIRONMENTAL SERVICES

CORRECTIVE ACTION PLAN
FOR
Site 25, BUILDING 1346, ZONE F

Site Identification # 14067

Charleston Naval Complex
North Charleston, South Carolina

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Contract Number N62467-99-C-0960

May 2001

JA Jones Environmental Services

TRANSMITTAL FORM

Project:	**Charleston Naval Shipyard**
DO Title:	Delivery Order '027
DO Project Location:	Charleston Naval Complex

Date: 01-Jun-01	**To:** Michael Bishop SCDHEC 2600 Bull Street Columbia , SC 29201-1708 803-898-4339	**From:** Brian R. Crawford J.A. Jones Environmental Services 1849 Avenue F North Charleston, South Carolina 29405 (843) 740-2780
Contract Number :		
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CC:	Project File	Dean Williamson	**Signed:**
	Gary Foster		
	Gabe Magwood		
	Tony Hunt		Brian R. Crawford

CORRECTIVE ACTION PLAN
FOR
Site 25, BUILDING 1346, ZONE F

Site Identification # 14067

Charleston Naval Complex
North Charleston, South Carolina

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston, South Carolina 29406

Submitted by:
CH2M-JONES, LLC.
Charleston Naval Complex
1849 Avenue F
North Charleston, South Carolina 29405

J.A. JONES
ENVIRONMENTAL
SERVICES

CH2MHILL

Contract Number: N62467-99-C-0960

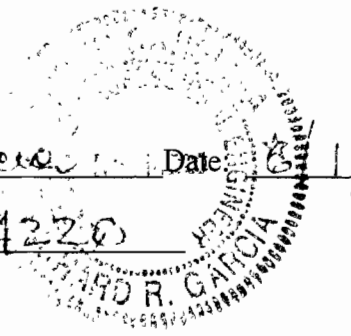
May 2001

CERTIFICATION

I certify that the information contained in this report is true, and complete to the best of my knowledge, information, and belief.

Approved By: E. Greene Date: 6/1/01

South Carolina Registration No. 14226



ACRONYMS

bls	below land surface
BTEX	benzene, toluene, ethylbenzene and xylenes
BRAC	Defense Base Realignment and Closure Act
CAP	Corrective Action Plan
CNC	Charleston Naval Complex
COC	Chemical of Concern
DPT	Direct Push Technology
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
GEL	General Engineering Laboratories
US EPA	United States Environmental Protection Agency
µg/kg	microgram per kilogram
µg/L	microgram per liter
MH/Jones	McLaren-Hart/Jones Division
MTBE	Methyl Tert-butyl Ether
ORC	Oxygen Releasing Compound
OVA	Organic Vapor Analyzer
PAH	Polycyclic Aromatic Hydrocarbons
QA	Quality Assurance
QC	Quality Control
RA	Rapid Assessment
RAR	Rapid Assessment Report
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation Recovery Act
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSTL	Site-Specific Target Level
TTNUS	Tetra Tech NUS
UST	Underground Storage Tank

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1.0 INTRODUCTION

This Corrective Action Plan (CAP) has been prepared by CH2M-JONES, LLC. The plan is designed for Site 25, Building 1346, Zone F; located at the Charleston Naval Complex (CNC), Charleston, South Carolina. Site 25 is located adjacent to Building 1346 at the intersection of Enterprise Avenue and Borie Street on the former CNC, Zone F in North Charleston, South Carolina. The site functioned as a gasoline station since the mid-1960s providing gasoline for private and government vehicles. Initial evidence that a release occurred at the site was discovered in 1991 during the closure of an underground storage tank (UST) system at the site.

Site 25 contains the locations of eight former petroleum UST systems used to supply retail gasoline to vehicles on base since the mid-1960s and were abandoned in place from 1976 to 1991. The South Carolina Department of Health and Environmental Control (SCDHEC) has designated this site as Identification Number 14067.

This CAP provides a method for active and passive remediation at the site including soil excavation and removal, the installation of an additional groundwater monitoring well in the source area, conducting groundwater monitoring to evaluate intrinsic remediation, and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. As a part of the soil excavation and removal activities, oxygen releasing compound (ORC) will be added to the excavation bottom to enhance the natural attenuation of chemicals of concern (COC) in groundwater. The CAP was developed using the information provided in the Rapid Assessment Report (RAR) for Site 25 prepared by Tetra Tech NUS, Inc. (TTNUS), dated November 1999. The applicable tables and figures from the RAR have been incorporated into this CAP.

1.1 General Site Description

The CNC is located in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina (Figure 1). This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base.

The area surrounding CNC is "mature urban", having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A Site Vicinity Map, that illustrates adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2. The subject site was a former naval exchange retail gasoline facility that had eight USTs buried on-site and later abandoned in place.

1.2 Site Background

The CNC began operations in 1901, when the Navy acquired the property. In 1993, the CNC was added to the list of bases schedule for closure under the Defense Base Realignment and

Closure Act (BRAC). BRAC regulates the closure of the base and transition of the property back to the community. With the scheduled closure of the base, environmental cleanup has proceeded to make the property available for redevelopment after closure.

Presently the site contains eight abandoned in place USTs, three active USTs, one structure (Building 1346), and a canopy covering the current and former dispensing locations. Recreational baseball and football fields are located immediately adjacent to the site on the northeast, east, and south sides, a school (unknown building number) is located to the southwest (approximately 300 feet away from the tank area), and buildings to the northwest. A second school is located approximately 600 feet to the northeast (Building 199).

According to the Initial Site Characterization prepared in 1991 by Westinghouse Environmental Services, the first USTs installed consisted of four 4,000-gallon steel USTs with steel piping located within the same tank basin and one 10,000-gallon steel UST located separately. The tanks, all used for gasoline, were listed as 1346-D, -E, -F, -G, and -H. The tanks were abandoned in place approximately in 1978.

The site was retrofitted with three 10,000-gallon steel tanks (1346-A, -B, and -C), during the period 1977 to 1981. These tanks were taken out of operation in February 1991 following a failed tank tightness test. As a result, three new 10,000-gallon fiberglass tanks with single-walled fiberglass piping were installed in 1991 (Tanks 1346-I, -J, and -K). The site is currently an active South Carolina Electric & Gas Company currently using the USTs. The USTs at the site contain various grades of unleaded gasoline, regular unleaded, unleaded plus, and super unleaded. The following table summarizes the USTs at Site 25.

UST I. D.	Install Date	Out of Service Date	Type	Size (gallons)	Contents
1346-D	1960s	~1978	Steel	4,000	Gasoline
1346-E	1960s	~1978	Steel	4,000	Gasoline
1346-F	1960s	~1978	Steel	4,000	Gasoline
1346-G	1960s	~1978	Steel	4,000	Gasoline
1346-H	1960s	~1978	Steel	10,000	Gasoline
1346-A	1970s	1991	Steel	10,000	Gasoline
1346-B	1970s	1991	Steel	10,000	Gasoline
1346-C	1970s	1991	Steel	10,000	Gasoline
1346-I	1991	Active	Fiberglass	10,000	Gasoline
1346-J	1991	Active	Fiberglass	10,000	Gasoline
1346-K	1991	Active	Fiberglass	10,000	Gasoline

From August 1991 through May 1998, Westinghouse Environmental and Geotechnical Services, Inc. and S&ME, Inc. conducted a field investigation at the subject site. To supplement the Westinghouse Environmental and Geotechnical Services, Inc. and S&ME, Inc. investigation, TTNUS completed a Rapid Assessment (RA) for the subject site. During the RA, TTNUS reviewed available documents, measured groundwater levels, and conducted Tier 1 and Tier 2 evaluations of the risk present at the site. The information from the Rapid

Assessment Report (RAR), prepared by TTNUS, dated November 1999, is summarized in Section 2.0 of this report. The RAR was approved by SCDHEC on February 29, 2000.

The site lies within the Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) Zone F, part of an ongoing RFI for the CNC facility. Information collected during the RFI, including geological data, hydrogeological data, well drilling logs, and groundwater sampling data, were used in the preparation of the RAR and the CAP.

2.0 RAPID ASSESSMENT SUMMARY

TTNUS completed a RAR, dated November 1999, for Site 25, Building 1346, Zone F. The assessment information was used to develop this CAP. The information from the RAR is summarized in this section.

2.1 Receptor Survey

A survey of the site vicinity was conducted by TTNUS personnel to identify potential receptors or petroleum hydrocarbon contamination. The Site Vicinity Map (Figure 2) depicts all known utilities located within 250 feet of the Building 1346 location. According to facility personnel, utility lines are typically located two feet to six feet below land surface (bls) (SPORTENVDETCHASN, 1999). The following utility receptors were located within a 250-foot radius of Building 1346.

- A water line is located at the northeast boundary of the site along South Avenue B and along the southeast side along Borie Street. The water line located between the canopy and Borie Street is approximately 50 feet southeast of the canopy and divides the area where UST basins are located. In addition, the line crosses the free product interception trench located on site near the corner of Borie Street and Enterprise Avenue.

- An 8-inch sanitary sewer line enters Building 1346 on the southwest side and extends southwesterly toward Enterprise Avenue. A sanitary sewer manhole is located approximately 30 feet south of the building. Four sanitary sewer manholes are located on Enterprise Avenue to the southwest.

- Three storm drainage catch basins are located on the north side of Building 1346. The storm drainage line originates near the canopy and extends northward toward a storm drain manhole located approximately 225 feet to the north at the corner of 9th Street and South Avenue B. Another storm drain manhole is located approximately 20 feet from the northwest corner of the canopy. A second storm utility line originates at a storm catch basin and storm manhole located approximately 20 feet from the south side of Building 1346 traversing the site northwesterly toward a storm manhole and catch basin along 9th Street.

In addition to the 250 feet radius receptor survey, TTNUS identified potential receptors and preferential pathways within a 1000 feet radius of the site and include the following:

- Construction workers in the water supply utility trench located approximately 20 feet northwest of MW-05 and MW-06.

- School located at the intersection of Avenue D and Borie Street located approximately 225 feet south-southwest of MW-06.

- Recreational football and baseball fields located 75 feet to 250 feet northeast, east, southeast, and south of the site.

- School located in building 199 located approximately 600 feet northeast of the site

- Groundwater at inactive industrial cooling water well located approximately 750 feet to the east of the subject site.

A survey of groundwater users within a 7 miles radius of CNC was performed for the RFI Report for Zone F (E/A&H, 1996). According to this report, a survey of groundwater users within a 7 miles radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no potable wells, which utilize the shallow aquifer, are located within a 4 miles radius of CNC.

An industrial well, located approximately 750 feet east of the site and upgradient, supplied water to a compressor house for cooling tower operations. A recent visit to the site by TTNUS (October 1999) revealed an abandoned pump house for the well (Building 716). The industrial well is therefore believed to be inactive. Irrigation wells were not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to Building 1346 is the Cooper River, located approximately 1,700 feet to the northeast.

The federal government currently owns the subject property and there is no city, county, or state zoning ordinances. Information concerning zoning ordinances was obtained from the Southern Division Naval Facilities Engineering Command (SOUTHDIV) Remedial Project Manager located at 2155 Eagle Drive, North Charleston, South Carolina 29406.

2.2 Assessment Information

TTNUS performed the following actions during the assessment:

- Reviewed Zone F, RFI Report, Charleston Naval Complex, (E&A/H, 1996) to identify potential sources and receptors for petroleum hydrocarbons in the vicinity, to evaluate public and private potable wells, to locate utility line areas, to locate nearby surface water bodies, and to determine surface hydrology and drainage.
- Reviewed previously prepared reports by Westinghouse Environmental and Geotechnical Services, Inc., and S&ME, Inc., on site activities dating from August 1991 to May 1998.
- Conducted site survey to identify utilities and to construct a site plan.
- Installed 28 soil borings to depths ranging from 4 feet to 12 feet bls using direct push technology.
- Collected soil samples for field screening using an organic vapor analyzer (OVA).
- Installed five temporary piezometers.
- Collected soil and groundwater samples from direct push technology (DPT) borings for on site mobile laboratory screening analysis for benzene, toluene, ethylbenzene, and total xylenes (BTEX); naphthalene; and diesel range organics.

- Collected and analyzed nine confirmation soil samples at a fixed-base analytical laboratory for BTEX and naphthalene using United States Environmental Protection Agency (US EPA) Method 8260, and polynuclear aromatic hydrocarbons (PAHS) using US EPA Method 8270.
- Collected and analyzed one soil sample from one soil boring for total organic carbon using US EPA Method 415.1 and total recoverable petroleum hydrocarbons using US EPA Method 9071.
- Collected and analyzed two soil samples from one soil boring for grain size analysis using sieve and hydrometer methods.
- Collected groundwater samples from nine existing permanent monitoring wells for laboratory analysis at a fixed-base analytical laboratory.
- Collected groundwater samples from three wells for natural attenuation parameters.
- Analyzed groundwater samples for BTEX, methyl tert-butyl ether (MTBE) and naphthalene using US EPA Method 8260; PAHs using US EPA Method 8270; and lead using US EPA Method 3030.
- Collected depth to groundwater measurements to evaluate the groundwater flow direction.

As reported in the RAR, the site lithology consists of interbedded layers of orange to red, tan, and gray to olive-green-gray, sandy clay, silty clay and sand near the surface to at least a depth of 12 feet bls. Groundwater levels ranged from 3 feet to 7 feet bls. Based upon groundwater level measurements collected on September 11, 1999, surficial groundwater flow is to the southwest.

During the RA, nine soil samples were collected on July 7, 1999, and were analyzed for BTEX, and PAHs by a fixed-base laboratory. Benzene concentrations exceeded risk- based screening level (RBSL) for sandy soils where groundwater depths are less than five feet bls in all site borings except one. Benzene concentrations ranged from six micrograms per kilogram (µg/kg) to 120,000 (µg/kg). Total naphthalene concentrations were detected above the RBSL in four boring locations with concentrations ranging between 18,000 (µg/kg) to 217,900 (µg/kg). A Soil COC Map is included as Figure 3.

2.3 Fate and Transport Modeling

Soil and groundwater concentrations exceed the RBSL, therefore, evaluation of site 25 continued beyond Tier 1. Fate and transport modeling is not required because both the source of contamination and the potential receptor are located on site, however modeling was performed because of the high concentrations on site.

The Domenico model was used to predict the distance at which the tip of the contaminant plume is attenuated to SCDHEC RBSLs in 10 and 20 years, respectively. The detailed results of the aquifer characterization calculated by TTNUS and the fate and transport parameters determined by TTNUS during the RA are presented in Section 2.8 of the TTNUS 1999 RAR.

2.4 Exposur Pathway Analysis

In the RA, TTNUS evaluated the receptor characterizations of the potentially exposed populations in the vicinity of the site and identified the potentially complete exposure pathways for those receptors. The only applicable potential pathway found was that protective of a construction worker potentially exposed to soil and groundwater in a utility trench. Complete details of the exposure pathway analysis can be found in the November 1999 TTNUS RAR.

2.5 Site-Specific Target Levels (SSTLs)

In the RA, TTNUS considered the following scenarios for the calculations of SSTLs: ingestion of, dermal contact with, or inhalation of vapors from subsurface soil for a construction worker in a trench; ingestion of, dermal contact with, or inhalation of vapors from contaminated groundwater by a construction worker in a trench. No other exposure routes pathways were considered likely threats.

SSTLs were calculated for soils for the COCs including BTEX and naphthalene because these soil contaminant concentrations exceeded RBSLs. Observed site concentrations of benzene, toluene, ethylbenzene, xylenes, and naphthalene in soil also exceeded their respective calculated SSTLs, therefore it was determined that BTEX and naphthalene in the soil may pose a threat to a construction worker in a utility trench.

SSTLs were calculated for benzene, toluene, and MTBE in groundwater because these groundwater contaminant concentrations exceeded their respective RBSLs. Observed site concentrations of benzene, toluene, and MTBE exceeded their respective calculated SSTLs, therefore it was determined that benzene, toluene, and MTBE in groundwater may pose a threat to the construction worker in a utility trench. A tabular summary of the soil and groundwater SSTLs and maximum on site concentrations are presented in Table 1.

Contaminant concentrations of BTEX and naphthalene in soil and benzene, toluene, and MTBE in groundwater exceeded the minimum calculated SSTLs protective of a construction worker in a utility trench. Therefore, the petroleum contamination detected at the subject site may pose a threat to construction workers in nearby utilities.

3.0 PROPOSED CORRECTIVE ACTIONS

The proposed corrective action is first to delineate the extent of the plume to get a better understanding of the source area. Several soil borings will be collected in various locations around the contaminated areas at Site 25. For each soil boring collected two intervals will be sampled. The first interval will be from 0-1 feet bls (below land surface) and the second interval will be from 3-5 feet bls. Groundwater in this area is approximately 4-5 ft bls. After the area has been properly delineated one of the following approaches may be used for active remediation. A Work Plan will be submitted prior to any active measures:

1) **An active remediation for impacted soils by excavation.**

Following delineation, the soils with elevated concentrations of contaminates will be excavated (source removal). The delineation sampling will define the contamination boundaries both horizontally and vertically to groundwater depth, which will allow CH2M-Jones, LLC to be able to remove those soils which are contaminated. One shallow monitoring well will be installed following excavation, which will be used in conjunction with the existing monitoring wells to monitor the groundwater. See Section 5.0 for details on the intrinsic remediation (groundwater sampling) plan.

2) **Excavation and application of ORC.**

Bioremediation of groundwater COCs may be performed concurrently and/or subsequently with excavation activities by applying ORC at the bottom of the soil excavation or injection following excavation. An additional groundwater monitoring well will be installed at the source area to monitor the progress of the groundwater remediation. If supported by monitoring data, intrinsic remediation followed by monitoring well abandonment will be implemented as a corrective action in accordance with SCDHEC Corrective Action Guidance, (June 1997). Intrinsic groundwater monitoring will continue until contaminant concentrations decrease below SSTLs or action levels approved by SCDHEC. Following the excavation, groundwater sampling will be initiated to evaluate the active and intrinsic remediation of the COCs. The proposed active remediation plan is described in Section 4.0, and the proposed intrinsic remediation plan is described in Section 5.0. One shallow monitoring well will be installed following excavation, which will be used in conjunction with the existing monitoring wells to monitor the groundwater. See Section 5.0 for details on the intrinsic remediation (groundwater sampling) plan.

3.1 Soil Remediation

Soil contamination was identified in the vicinity of the former UST basins located southeast of building 1346 at the subject site. BTEX and naphthalene were found above their respective RBSLs in soil samples collected between 1 foot and 4 feet bls in the previously mentioned former UST basin area (Figure 3). Soil sampling will be conducted to delineate the soil contamination at the source area. Soil samples will be analyzed for BTEX and naphthalene. Proposed soil boring locations are identified in Figure 2, however site conditions may require

additional soil samples to be collected. Areas with low levels of contamination will either be excavated or treated by ORC injection/ application to provide natural degradation of the contaminates.

3.2 Groundwater Remediation

Groundwater contamination was identified in the vicinity of the former UST basin area located at the southeast portion of the site. Contaminant concentrations in groundwater exceeded the RBSLs for BTEX, naphthalene and MTBE in monitoring well MW-5 and MTBE in monitoring wells MW-6 and 609004. Pending on the delineation results, it is possible that following the proposed soil excavation and removal activities, ORC will be placed at the bottom of the excavation and allowed to naturally disperse to the outer edges of the groundwater COC plume. Groundwater monitoring will then be used to evaluate the effectiveness of the ORC on the reduction of the COC concentrations.

4.0 PROPOSED ACTIVE REMEDIATION

Active remediation of the site will include limited removal of source area soils, conducting groundwater monitoring to evaluate the active remediation of the site and possibly including addition of ORC to the base of the excavation.

4.1 Soil Excavation and Removal Activities

Soil sampling completed during the TTNUS RA identified locations CNC25-B09 through CNC25-B13, and CNC25-B17 having levels of COCs above SSTLs which were used as indicators to delineate the source area for excavation at the site. To further delineate the source area prior to excavating, 10 to 15 soil borings will be used to delineate COCs in soil to levels that are less than SSTLs. Proposed soil boring locations are illustrated on Figure 2. Excavation will commence within the delineated source area. The soil samples from the proposed soil borings will be submitted to a certified laboratory and analyzed for BTEX and naphthalene using US EPA Method 8260.

To prevent any structural damage to building 1346, there will be at least three feet between the edges of the excavation and the building and excavation edges will have a 1:1 side slope. All soil removed from the site will be taken off site to an approved disposal facility. Prior to backfilling the excavation, ORC may be added (estimated amount of ORC slurry mixture to be determined after delineation) to the base of the soil excavation to aid in the stimulation of aerobic microorganisms for remediation of groundwater at the site. The excavation will be backfilled and compacted, and resurface to existing conditions.

Prior to excavating, the utilities will be cleared by local utility markers. Hand digging will be performed prior to backhoe excavation to determine the exact locations of utility pipes if needed. A water supply pipe run is expected to be encountered at approximately two feet to six feet bls near the southeast boundary of the excavation.

4.2 Equipment Decontamination

All drilling equipment soil sampling equipment involved in field sampling activities will be decontaminated according to the EPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).

4.3 Sample Handling

Sample handling will be conducted in accordance to the following references: EPA EISOPQAM, Code of Federal Regulations 136, 1990, and EPA Users Guide to Contract Laboratory Program, 1988. The following forms will be completed for packing/shipping process: sample labels, chain-of-custody labels, appropriate labels applied to shipping coolers, and chain-of-custody forms.

4.4 Quality Control

In addition to periodic calibration of field equipment and the completions of the appropriate documentation, quality control (QC) samples will be collected during sampling events. QC samples may include field blanks, field duplicates, and trip blanks. Definitions of each can be found below as described by the EPA EISOPQAM:

- **Field Blank:** A sample collected using organic-free water, which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.

- **Field Duplicates:** Two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contamination associated with a population.

- **Trip Blank:** A sample, which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event. They are often packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If samples are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

4.5 Field Quality Assurance / Quality Control (QA/QC)

All sampling procedures will be conducted in accordance with EPA EISOPQAM. More information on field QC can be found in Sections 4.2 through 4.4.

QA/QC specifications for selected field measurements are summarized below.

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check Calibration of OVA daily	Calibrate to manufactures specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH = 7.0	Recalibrate. If unable to calibrate, replace electrode.
Specific Conductance of water	Continuing calibration check of standard solution	> 1% of standard	Recalibrate.

4.6 Record Keeping

In addition to required sampling documentation (see Section 4.3), standardized forms, log sheets and logbooks will be completed during all field activities.

4.7 Reporting

Following soil excavation and monitoring well installation activities, a status report will be submitted to SCDHEC. The report will summarize the field and laboratory analytical data obtained during the soil sampling and excavation activities.

5.0 PROPOSED INTRINSIC REMEDIATION

This CAP provides a method for implementing intrinsic remediation and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. Intrinsic remediation by continued groundwater monitoring will be implemented upon completion of the active remediation until contaminant concentrations decrease to levels approved by SCHDEC.

5.1 Monitoring Well Installation

One proposed monitoring well (CNC25-M09) would be installed at the site. The new monitoring well will be located immediately down gradient of the source to monitor the effectiveness of the intrinsic remediation nearest to the source area. A Groundwater Potentiometric Surface Map (Figure 5) from the March 26, 2001 gauging event illustrates groundwater flow to the southwest, which is consistent with historical data. The location of the proposed well is shown on Figure 2. The well will be installed to the same specifications as existing shallow monitoring wells. The well will consist of 2-inch diameter polyvinyl chloride well casing installed to a depth of 12 feet bls with a 0.01 inch slotted screened interval from 2 feet to 12 feet bls.

If any wells are unusable or new wells are warranted for any other reason, the wells will be installed to the same specifications as existing monitoring wells unless site conditions change and warrant otherwise. The wells will be installed in accordance with South Carolina Well Standards and Regulations R.61-71. A utility locate will be completed prior to any well installation activities. Any necessary permits will be acquired prior to well installation activities.

5.2 Surveying

Newly installed monitoring well CNC25-M09 will be surveyed and tied in to the existing monitoring wells on site for vertical elevation and horizontal map location.

5.3 Monitoring Well Abandonment

All monitoring wells will be abandoned upon receiving approval by SCDHEC. The wells will be abandoned following the South Carolina Well Standards and Regulations R.61-71. The well abandonment will include grouting wells, removing stick-ups and removing all guard posts. Any well casing and screen removed will be decontaminated and disposed of as general refuse.

5.4 Sampling and Analysis Plan

Groundwater monitoring will occur quarterly the first year and a half for all wells or until the COC concentrations fall below SSTLs for two consecutive sampling events following active remediation. Groundwater samples will be sent to a certified laboratory and analyzed for BTEX, MTBE, and naphthalene using EPA Method 8260. Natural attenuation parameters

(dissolved oxygen, pH, oxidation/reduction potential, and electrical conductivity) may will also be collected in the field from all wells during each sampling event. In addition to the natural attenuation parameters obtained in the field, laboratory samples for nitrate, sulfate, alkalinity, Fe^{2+}, and Fe^{3+} will be obtained during the first round of groundwater sampling to further supplement the evaluation of the intrinsic remediation processes.

All sampling procedures will be conducted in accordance with EPA EISOPQAM and Ensafe/ Allen & Hoshall, Comprehensive Sampling and Analysis Plan, 1996.

5.5 Reporting

Quarterly monitoring reports will be submitted to SCDHEC. The reports will summarize and include copies of field and laboratory analytical data from the intrinsic monitoring activities. Upon completion of the intrinsic remediation, a Performance Evaluation Report will also be submitted to SCDHEC to summarizes the remediation activities and provide recommendations for the site.

6.0 SITE MANAGEMENT AND BASE SUPPORT

Throughout the investigation activities, work on the CNC will be coordinated through SOUTHDIV and SCDHEC.

The primary contacts for each are as follows:

1. SOUTHDIV point of contact
   Gabe Magwood
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
   (843) 820-7307

2. SOUTHDIV point of contact
   Tony Hunt
   Southern Division Engineering Command
   2155 Eagle Drive
   North Charleston, SC 29406
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3. SCDHEC point of contact
   Chris Doll
   South Carolina Department of Health and Environmental Control
   2600 Bull Street
   Columbia, SC 29201
   (843) 898-4300

7.0 REFERENCES

E/A&H (EnSafe/Allen & Hoshall, Inc.), 1996. Zone F RCRA Facility Investigation Report, Naval Base Charleston, Charleston, South Carolina, 1996.

South Carolina Department of Health and Environmental Control 1997. Corrective Action Guidance.

Tetra Tech NUS, Inc. November 1999. Rapid Assessment Report for Site 25, Building 1346, Zone F, North Charleston, South Carolina.

United States Environmental Protection Agency. 1996. EPA Environmental Investigations Standard Operating Procedures for Quality Assurance Manual.

SPORTENDETCHASN (Supervisor of Ship Building, Conversion and Repair, United States Navy, Portsmouth, Virginia, Environmental Detachment Charleston), 1999. Personal contact between Paul Calligan TTNUS and Copes Wannamacker SPORTENDETCHASN, June 17, 1999.

TABLE 1

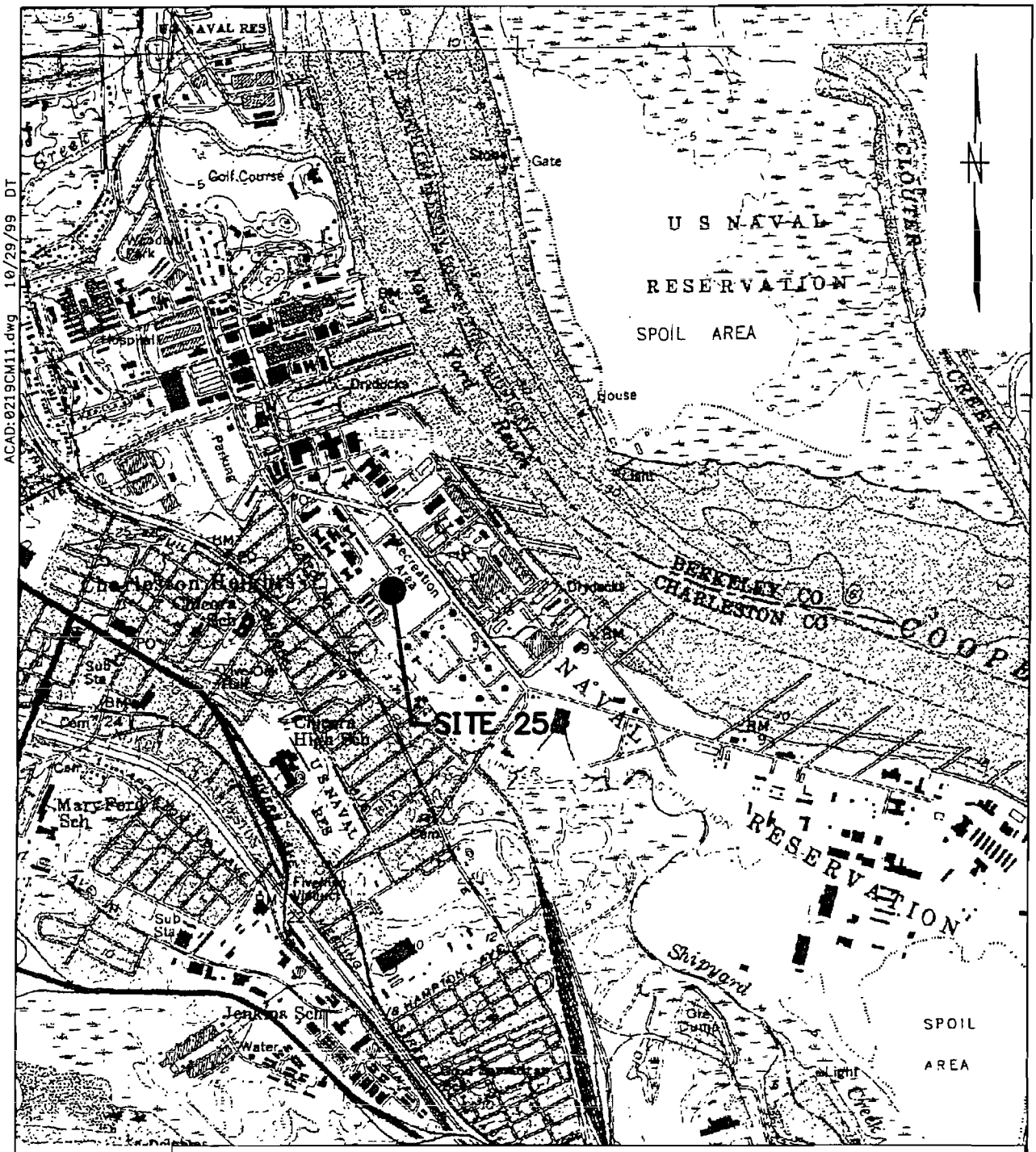
SUMMARY AND COMPARISON OF THE SELECTED SSTLs

The following table summarizes the calculated SSTLs according to media (for exposure) and exposure pathway for the CoCs that may be a threat to the identified receptor construction worker in an onsite utility trench.

Media (for exposure)	Exposure Pathway	CoC	Unit	SSTL	Maximum Onsite Concentration	Greater than SSTL?
Groundwater	Dermal contact, inhalation, or ingestion	Benzene	mg/L	**0.15**	26	Yes
		Toluene	mg/L	**5.38**	38	Yes
		MTBE	mg/L	**25.92**	33	Yes
Soil (leaching from groundwater)	Dermal or incidental ingestion	Benzene	mg/kg	**0.2**	120	Yes
		Ethylbenzene	mg/kg	**14.5**	560	Yes
		Toluene	mg/kg	**11**	360	Yes
		Xylenes	mg/kg	**686**	2200	Yes
		Naphthalenes	mg/kg	**24**	218	Yes
Soil (leaching from groundwater)	Volatilization or inhalation	Benzene	mg/kg	**0.2**	120	No
		Ethylbenzene	mg/kg	**14.5**	560	No
		Toluene	mg/kg	**11**	360	No
		Xylenes	mg/kg	**686**	2200	No
		Naphthalenes	mg/kg	**24**	218	No

The above SSTLs should be used for establishing cleanup levels at the site.

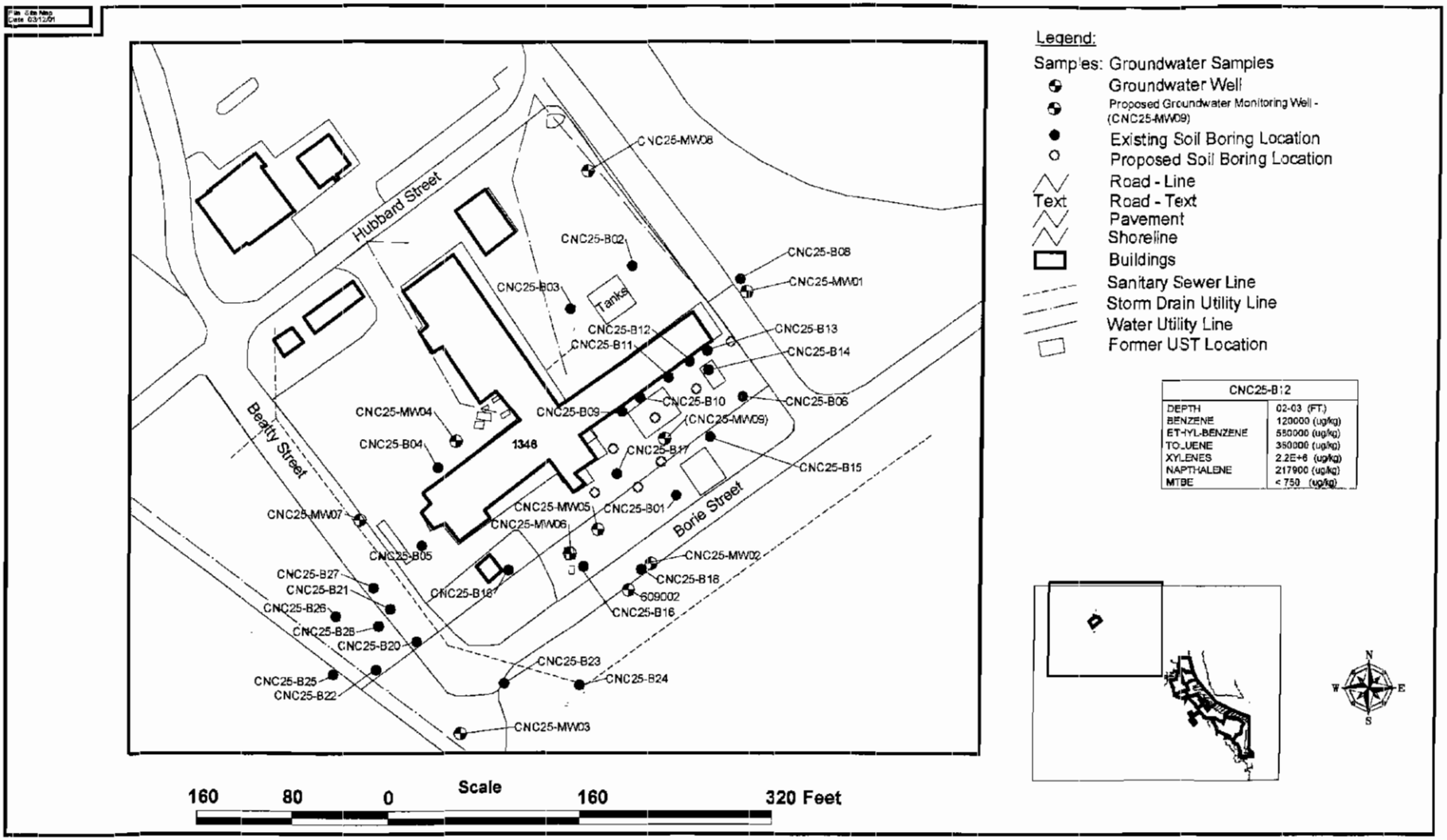
FIGURES



ACAD:0219CM11.dwg 10/29/99 DT

DRAWN BY DATE: DLT 10/29/99		SITE LOCATION MAP SITE 25, BUILDING 1346 ZONE F, CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA	CONTRACT NO. 0219
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED—AREA			APPROVED BY DATE
SCALE: AS NOTED			DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98



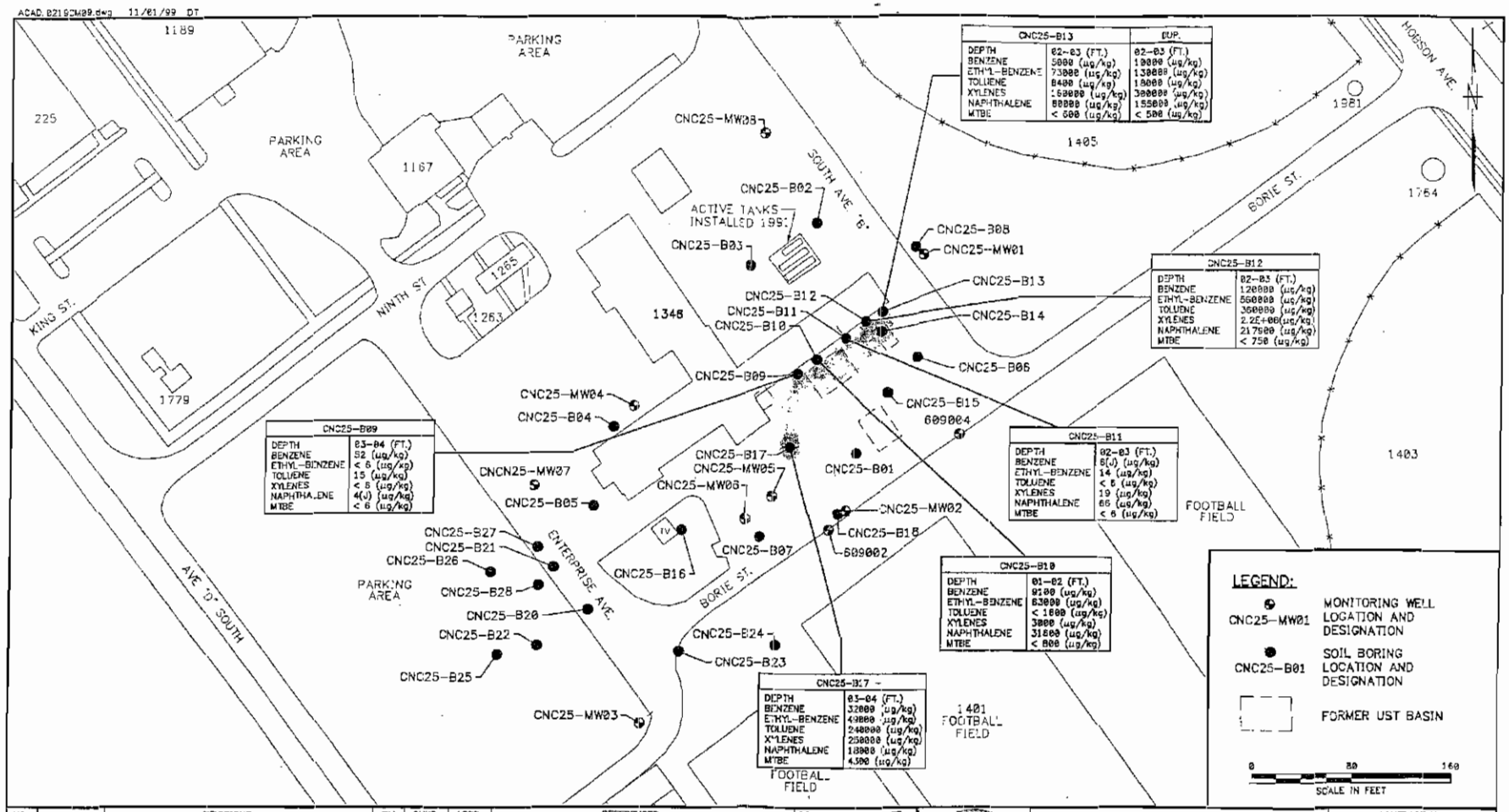
REV#	DATE	DESCRIPTION	APP'D

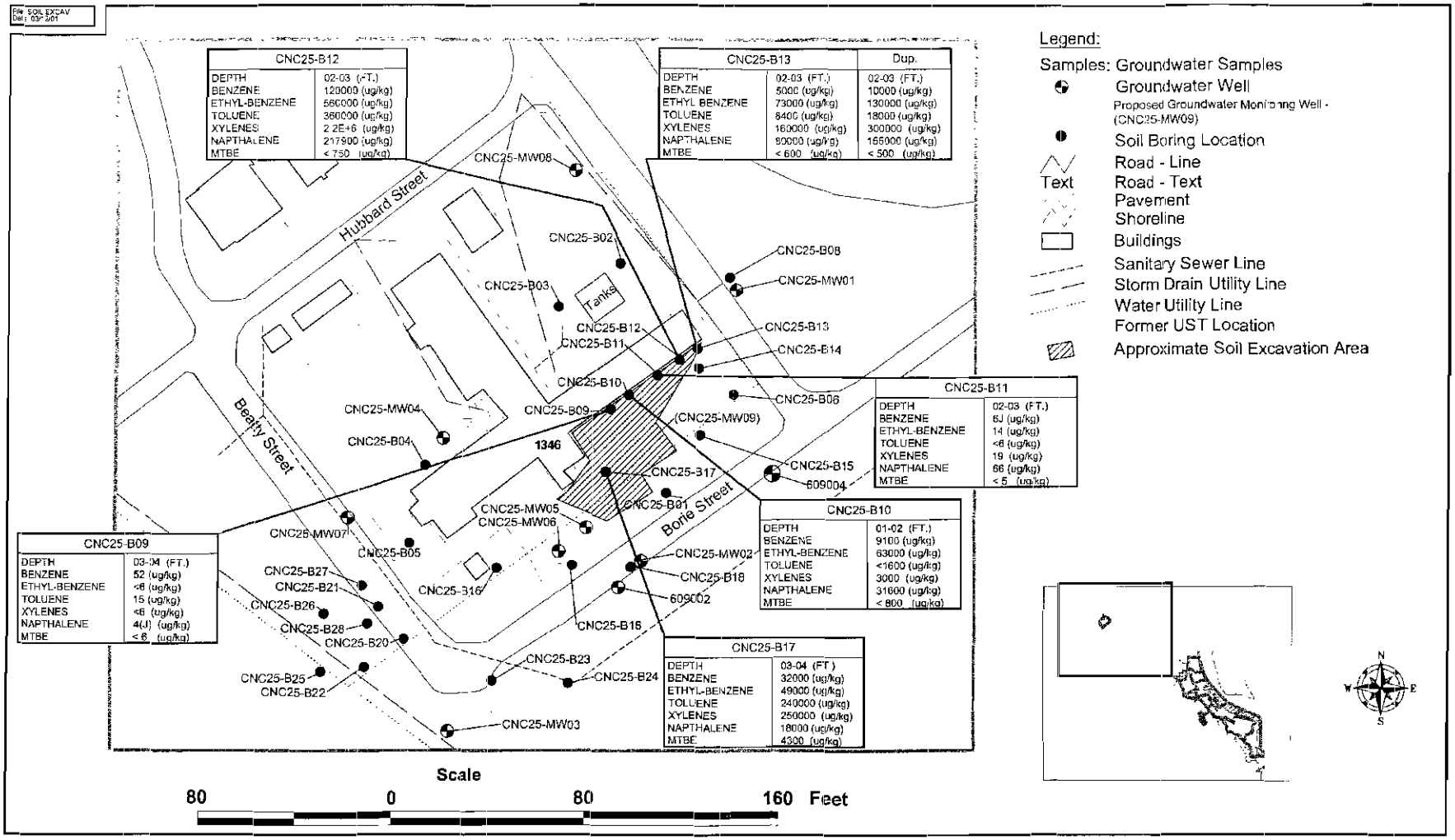
LA JONES ENVIRONMENTAL SERVICES

SITE VICINITY MAP

Site 25, Building 1346, Zone F, Charleston Naval Complex
North Charleston, South Carolina

DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/19/01
APP'D:	**FIGURE 2**


ACAD, B219CM09.dwg 11/01/99 DT
1189
PARKING AREA
225
PARKING AREA
1167
1265
1263
KING ST.
NINTH ST
1779
1348
SOUTH AVE "B"
ACTIVE TANKS INSTALLED 1991
HOBSON AVE.
1981
1405
BORIE ST.
1764
1403
FOOTBALL FIELD
1401 FOOTBALL FIELD
AVE "D" SOUTH
ENTERPRISE AVE.
PARKING AREA
BORIE ST.
CNC25-MW08
CNC25-B02
CNC25-B03
CNC25-B08
CNC25-MW01
CNC25-B13
CNC25-B12
CNC25-B11
CNC25-B10
CNC25-B14
CNC25-B06
CNC25-B09
CNC25-MW04
CNC25-B04
CNC25-B15
609004
CNCN25-MW07
CNC25-B05
CNC25-B17
CNC25-MW05
CNC25-MW06
CNC25-B01
CNC25-MW02
CNC25-B18
609002
CNC25-B07
CNC25-B16
CNC25-B27
CNC25-B21
CNC25-B26
CNC25-B28
CNC25-B20
CNC25-B22
CNC25-B25
CNC25-B24
CNC25-B23
CNC25-MW03
CNC25-B13 / DUP.
DEPTH 02-03 (FT.) / 02-03 (FT.)
BENZENE 5000 (ug/kg) / 10000 (ug/kg)
ETHYL-BENZENE 73000 (ug/kg) / 130000 (ug/kg)
TOLUENE 8400 (ug/kg) / 15000 (ug/kg)
XYLENES 160000 (ug/kg) / 300000 (ug/kg)
NAPHTHALENE 80000 (ug/kg) / 155000 (ug/kg)
MTBE < 500 (ug/kg) / < 500 (ug/kg)
CNC25-B12
DEPTH 02-03 (FT.)
BENZENE 120000 (ug/kg)
ETHYL-BENZENE 560000 (ug/kg)
TOLUENE 350000 (ug/kg)
XYLENES 2.2E+06(ug/kg)
NAPHTHALENE 217500 (ug/kg)
MTBE < 750 (ug/kg)
CNC25-B09
DEPTH 03-04 (FT.)
BENZENE 52 (ug/kg)
ETHYL-BENZENE < 6 (ug/kg)
TOLUENE 15 (ug/kg)
XYLENES < 6 (ug/kg)
NAPHTHALENE 4(J) (ug/kg)
MTBE < 6 (ug/kg)
CNC25-B11
DEPTH 02-03 (FT.)
BENZENE 8(J) (ug/kg)
ETHYL-BENZENE 14 (ug/kg)
TOLUENE < 6 (ug/kg)
XYLENES 19 (ug/kg)
NAPHTHALENE 66 (ug/kg)
MTBE < 6 (ug/kg)
CNC25-B10
DEPTH 01-02 (FT.)
BENZENE 9100 (ug/kg)
ETHYL-BENZENE 63000 (ug/kg)
TOLUENE < 1600 (ug/kg)
XYLENES 3800 (ug/kg)
NAPHTHALENE 31800 (ug/kg)
MTBE < 800 (ug/kg)
CNC25-B17
DEPTH 03-04 (FT.)
BENZENE 32000 (ug/kg)
ETHYL-BENZENE 49000 (ug/kg)
TOLUENE 240000 (ug/kg)
XYLENES 250000 (ug/kg)
NAPHTHALENE 18000 (ug/kg)
MTBE 4500 (ug/kg)
LEGEND:
CNC25-MW01 MONITORING WELL LOCATION AND DESIGNATION
CNC25-B01 SOIL BORING LOCATION AND DESIGNATION
FORMER UST BASIN
0 80 160
SCALE IN FEET
NO. DATE REVISIONS BY CHKD APPD REFERENCES
DRAWN BY DLT DATE 10/29/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED
SOIL CoC MAP
SITE 25, BUILDING 1346
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
CONTRACT NO. 0219
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3
REV. 0
FORM CADD AD SDIV_BLDWG - REV 6 - 1/28/98



REV#	DATE	DESCRIPTION	APP'D

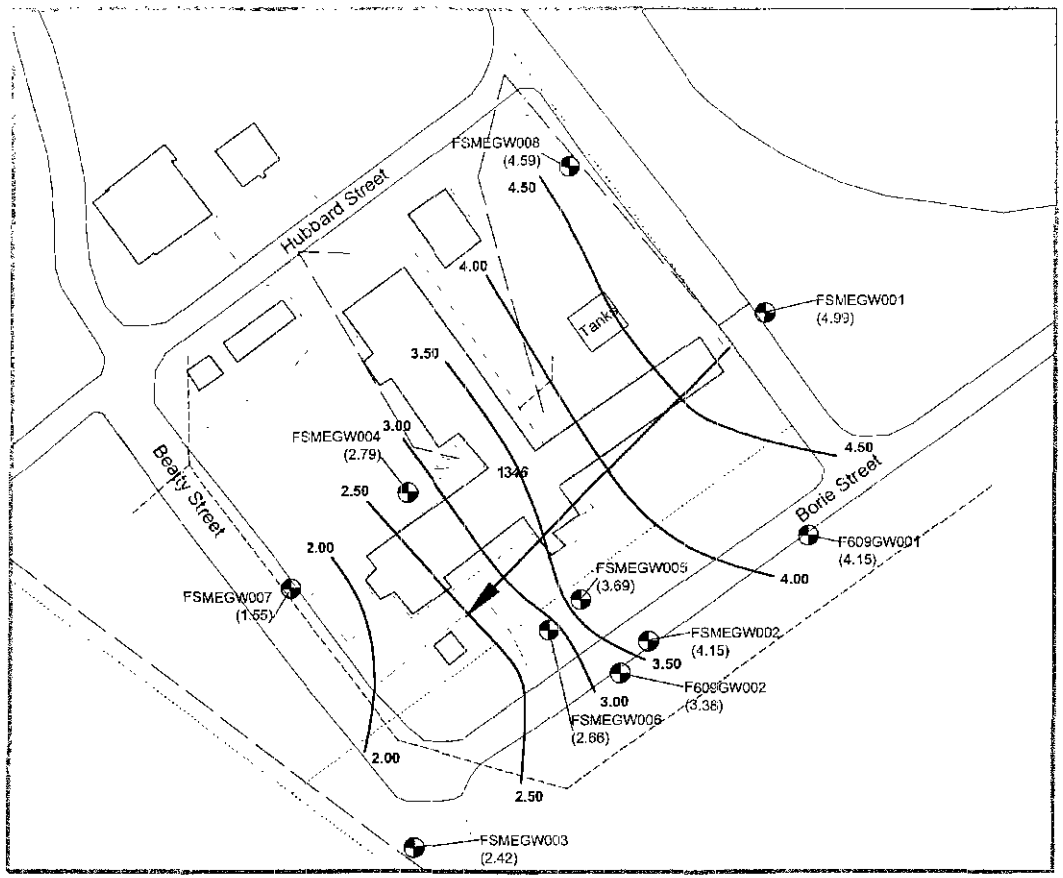
J.A. JONES ENVIRONMENTAL SERVICES

APPROXIMATE SOIL EXCAVATION MAP

Site 25, Building 1346, Zone F, Charleston Naval Complex
North Charleston, South Carolina

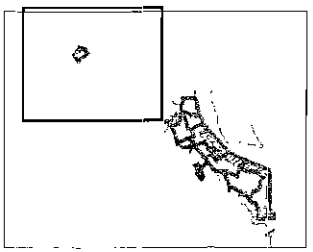
DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/19/01
APP'D:	FIGURE 4

File: GW4-28-01
Date: 5/31/01



Legend:

Samples: Groundwater Samples
Groundwater Well
Road - Line
Text Road - Text
Pavement
Shoreline
Buildings
Sanitary Sewer Line
Storm Drain Utility Line
Water Utility Line
Former UST Location
Groundwater Potentiometric Surface Contour (MSL)
Groundwater Flow Direction
(4.15) Groundwater Elevation (MSL)



REV#	DATE	DESCRIPTION	APP'D

J.A. JONES ENVIRONMENTAL SERVICES

Groundwater Potentiometric Surface Map 3/26/01

Site 25, Building 1346, Zone F, Charleston Naval Complex
North Charleston, South Carolina

DRWN: DTB	SCALE: AS SHOWN
CHK'D:	DATE: 04/19/01
APP'D:	**FIGURE 5**